The Sector 7 Ultrafast Laser Lab for Time-Resolved Research

A recently completed laser laboratory located at the end of the XOR sector 7-ID beamline will benefit the users of femtosecond lasers at the APS by improving existing research programs, making more efficient use of available beamtime, and increasing safety.

The laser-only room, designated 7-ID-E, (Fig. 1), is complemented by a new ultrafast laser amplifier that was funded jointly by the XRS Time-Resolved X-ray Research Group and the Argonne Chemistry Division's Atomic Physics Group. The amplified femtosecond laser is unique to the APS (2.5 W, < 50 fs pulse duration, 1 or 5 KHz repetition rate). Its stability, beam quality, and high pulse energy have resulted in several successful experiments since its installation in the fall of 2004.

The new laser enclosure (Fig. 2) provides additional space that will make possible future development of a number of new instruments, such as a high-repetition-rate ultrafast laser to match the standard APS fill pattern, an adaptive optical system for generating custom laser waveforms, and dedicated doubled and tripled light laser beam paths, etc. Beamline 7-ID-E is currently delivering laser beam directly to 7-ID-D for general time-resolved x-ray experiments, but eventually the laser will be delivered via beam pipes to x-ray-technique-specific upstream hutches for microprobe, surface science, and white beam studies. Placing the laser in a separate lab has not only been good for the laser (which needs a fair amount of regular maintenance), but has also freed up valuable x-ray hutch real estate. The arrangement also permits simultaneous "tweaking up" or reconfiguration of the laser while x-ray setup is under way, thus saving a considerable amount of time.

The major justification for a new separate laser enclosure is the potential user community that requires such a facility: the hundreds of research groups worldwide that build or use femtosecond lasers. The transient phenomena studied by time-resolved researchers cannot be pre-prepared and transported as a sample to a beamline. Instead, this research requires duplication at a beamline of the same type of conditions under study at a scientist's home institution. Proper use of an ultrafast laser as a measurement instrument takes as much time to set up as an x-ray experiment. The value of an ultrafast laser as a tool to study time-resolved phenomena is essentially lost unless a laboratory is available that can be set up and used off-line (i.e., not during x-ray beamtime). To illustrate this, the laser system has been on for a large fraction of the January 2006 shutdown, with users commissioning a new mass spectrometer. *Contact: Eric Landahl (elandahl@anl.gov)*

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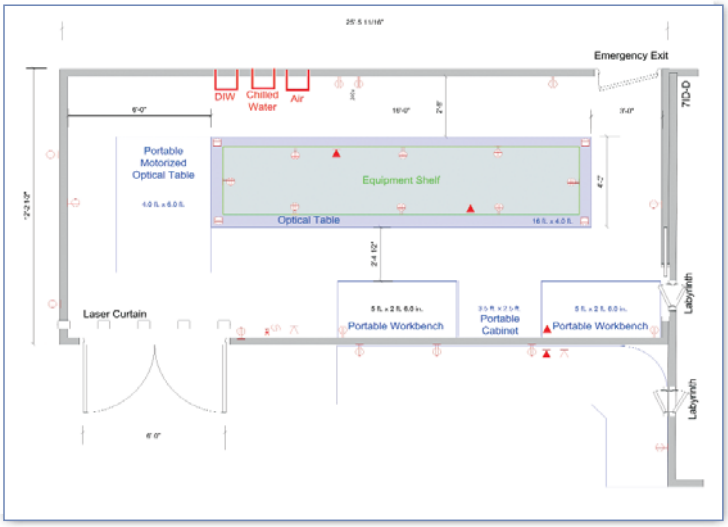

Fig. 1. Drawing of the laser enclosure.

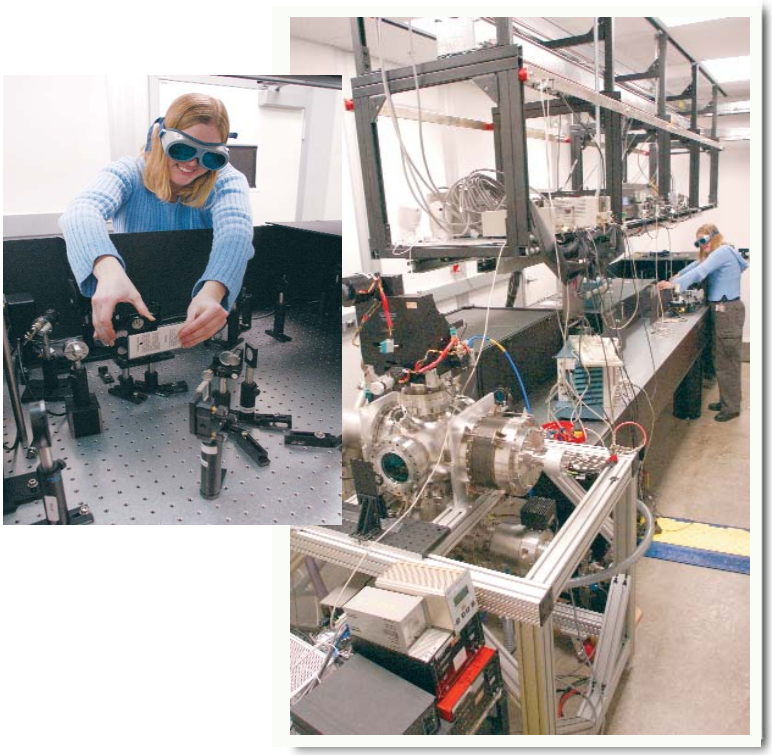

Fig. 2. Emily Peterson (Argonne Chemistry Division) inside the new sector 7 laser lab. The amplified laser system is at the far end and shown in closeup at left above.